

UNIT I

INTRODUCTION TO RCM

Module 1

INTRODUCTION TO RCM

INTRODUCTION TO RCM

Module Preview:

**Introductio
n**

Introduction

RCM Defined

History of RCM

Benefits of RCM

RCM References

Review and Summary

INTRODUCTION TO RCM

Module Objective:

Introduction

**This module will provide an overview of
Reliability-Centered Maintenance (RCM):**

- 1. Provide a definition of Reliability-Centered Maintenance**
- 2. Describe the history of RCM**
- 3. Identify the benefits of RCM**
- 4. Provide RCM reference materials**

INTRODUCTION TO RCM

What is RCM ?

Introduction

Before focusing on the details of how to perform a Reliability-Centered Maintenance (RCM) analysis, it is useful to understand ...

- **What RCM is**
- **Where it came from**
- **What benefits it provides and**
- **What part it plays in a maintenance program**

INTRODUCTION TO RCM

What is RCM?

RCM Defined

Reliability-Centered Maintenance (RCM)

An analytical process used to determine appropriate failure management strategies to ensure safe and cost-effective operations of a physical asset in a specific operating environment.

Failure Management strategies

- **Preventive Maintenance (PM) requirements**
- **Other actions**
- **Run to failure**

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What is RCM?

RCM Defined

- **Goal of RCM**
 - Avoid or reduce failure **CONSEQUENCES**
 - Not necessarily to avoid failures
- ***Failure Consequences are the effects of failure on:***
 - **Personal and Equipment Safety**
 - **Environmental Health/Compliance**
 - **Operations**
 - **Economics**

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What is RCM?

RCM Defined

- **Currently there are many processes that call themselves RCM**
- **SAE JA1011 provides criteria to distinguish processes that follow the original tenets of RCM**
- **This course is based on the RCM methodology defined in NAVAIR 00-25-403**

INTRODUCTION TO RCM

What is RCM?

RCM Defined

SAE JA1011 “Evaluation Criteria for RCM Processes” defines seven questions for RCM:

- **What are the functions...of the asset...(functions)?**
- **In what ways can it fail...(functional failures)?**
- **What causes each functional failure (failure modes)?**
- **What happens when each failure occurs (failure effects)?**
- **In what way does each failure matter (failure consequences)?**
- **What should be done...(proactive tasks and intervals)?**
- **What should be done if a suitable proactive task cannot be found?**

Also requires a “Living Program”

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What is RCM?

RCM Defined

NAVAIR RCM Process as defined in NAVAIR 00-25-403 meets SAE JA1011

- **Built on FMECA and Failure Consequence determinations (questions 1 through 5)**
- **Establishes task and interval evaluation process (question 6)**
- **Considers “other actions” and “No PM” (question 7)**
- **Requires RCM Sustainment and Age Exploration (Living Program)**

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Which Process?

RCM Defined

NAVAIR 00-25-403 RCM process:

- Evolved over nearly 30 years
- Used in on a variety of equipment in various applications
- Continuously improved
 - ✓ **NAVAIR RCM Steering Committee**
- Complies with **SAE JA1011**
- **Public Domain**

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RCM History:

History of RCM

- **Early PM Programs based on concept that periodic overhauls ensured reliability and, therefore, safety**

Overhaul: Tearing down and rebuilding components

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RCM History:

History of RCM

- **1960s:**
 - **Introduction of 747, DC-10, L-1011 led airlines to conclusion that current preventive maintenance philosophies were unsustainable**
 - **FAA and Commercial Aviation Industry formed a group to study preventive maintenance**

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RCM History:

History of RCM

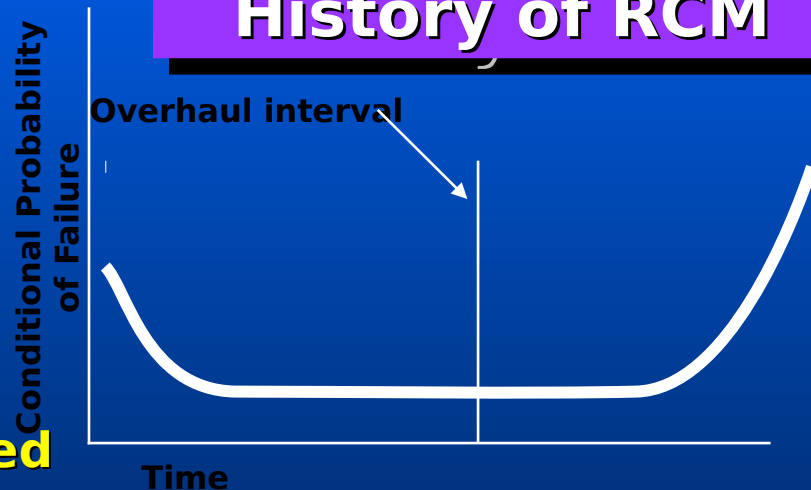
- **1960s: (continued)**
 - **FAA/Airline Group conclusion: overhauls had little or no effect on overall reliability or safety in many cases**
 - **Why?**

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RCM History:

**OVERHAUL PHILOSOPHY
ASSUMES THIS
IS TRUE...**

History of RCM



What the airlines discovered

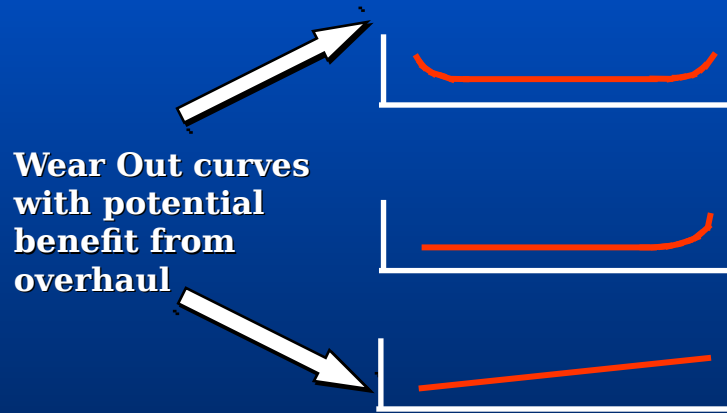
- Statistical analysis showed, in most cases, no change in safety or reliability when overhaul limits changed.
- Initial overhaul limits were not analytically based.
- High repair costs for little or no benefits.

Facts about overhauls

- Many failure modes do not support overhaul philosophy- have no 'right' overhaul time.
- Lose considerable component life.
- Overhauls re-introduce infant mortality failures.

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WEAR OUT CURVES



UAL
1968

Broberg
1973

MSP
1982

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3%

3%

2%

1%

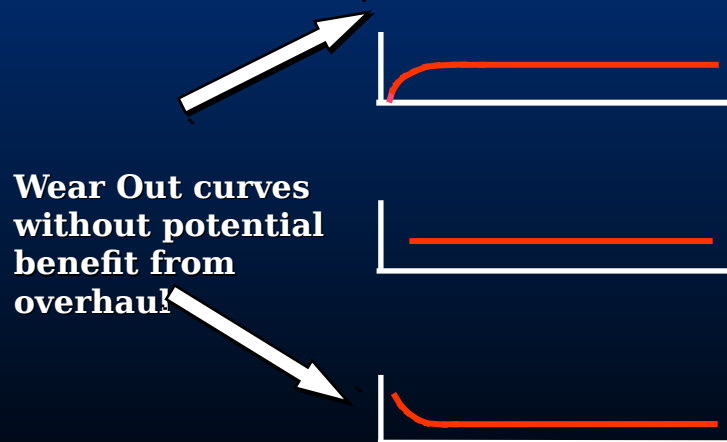
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from 8%
to 23%



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Ranges
from 77%
to 92%

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RCM History:

History of RCM

1965: Studies show scheduled overhaul of complex equipment has little or no effect on in-service reliability

1967-68: Airline and manufactures form Maintenance Steering Group (MSG) and produce **MSG 1**, “ Handbook: Maintenance Evaluation and Program Development.”
First applied to Boeing 747

1970: MSG handbook updated to **MSG-2**, “Airline/ Manufactures Maintenance Program Planning Document”. Applied to L-1011 and DC-10

1972: MSG-2 techniques applied to NAVAIR systems (P-3A, S-3A, and F-4J)

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RCM History:

History of RCM

1975: NAVAIR applied Analytical Maintenance Program to Naval aircraft and engine programs, using MSG-2 type logic ([NAVAIR 00-25-400](#))

1978: Department of Defense (DOD) sponsored DOD report [AD-A066579](#), “Reliability Centered Maintenance” by Nowlan and Heap - Updates MSG-2 approach with better guidance on process and interval determination

1980: Army issued [Army Pamphlet 750-40](#), “Guide to RCM for Fielded Equipment ”

1981: DOD issued [MIL-HDBK-266](#), “Application of RCM to Naval Aircraft, Weapon Systems and Support Equipment” to implement RCM concepts from DOD report AD-A066579

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RCM History:

History of RCM

1983: MSG-3 issued. Used in design of Boeing 757 and 767 aircraft. Added emphasis on structural inspection programs. Similar to RCM, but lacked guidance on interval determination

1985: US Air Force (USAF) issued MIL-STD-1843, "RCM Requirements for Aircraft, Engines and Equipment" - Similar to MSG-3 (Cancelled without replacement in 1995, USAF Instructions contain current policy/guidance)

1986: NAVAIR issued MIL-STD-2173, "RCM Requirements for Naval Aircraft, Weapons Systems and Support Equipment". Superseded MIL-HDBK-266 & NAVAIR 00-25-400

➤ NAVAIR 0-25-403 issued containing Age Exploration guidance.

1992: Coast Guard issued CGTO PG-85-00-30, 

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RCM History:

History of RCM

- RCM success in Aviation industry noted by other industries - Nuclear Power and Space industries adopt approach due to focus on avoiding “**safety consequences**”
- “RCM II” by John Moubray published in UK in 1990
- “Reliability-Centered Maintenance” by Mac Smith published in US in 1993
- As interest in increased, a variety of other processes called themselves “RCM”

Industry interest in SAE JA1011 and JA1012 was to identify “valid” RCM approaches

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RCM History:

History of RCM

1996: NAVAIR updated **NAVAIR 00-25-403** to contain complete RCM process due to cancellation of MIL-SPEC's

1999: SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) issued **SAE JA1011**, "Evaluation Criteria for RCM Processes" - establishes criteria for RCM processes (NAVAIR and Aladon/John Moub-ray major contributors)

2001: NAVY updated **NAVAIR 00-25-403** to capture improvements developed during SAE JA1011 work - provides primary guidance for implementing NAVAIR RCM program or performing RCM analysis (Current edition March 2003)

2002: SAE issued **SAE JA1012**, "A Guide to the RCM Standard" - amplifies and clarifies key concepts and terms from SAE JA1011

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Benefits of RCM

RCM Benefits

If performed properly, RCM will:

- **Maximize safety and environmental health**
- **Depending on objective:**
 - **Reduce overall maintenance cost**
 - **Improve realized reliability/availability**
- **Provide a documentation trail for maintenance program changes**
- **Provide a vehicle for continuous improvement of the maintenance program and equipment performance**

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References:

RCM References

- **NAVAIR RCM Website** - This site provides easy access to Naval Air Systems Command (NAVAIR) RCM policies and tools.
 - **<http://logistics.navair.navy.mil/rcm>**
- **NAVAIR 00-25-403** - This manual covers *planning* for RCM, *RCM theory* and specific guidance for *performing* the analysis, and *implementing* analysis results.
 - **Available at NAVAIR Website**
- **SAE JA1011**- This document is intended to be used to evaluate any process that claims to be an RCM process.
 - **Available from SAE via web**
- **SAE JA1012 - A Guide to the Reliability-Centered Maintenance Standard.**

Available from SAE via web

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References:

RCM References

- **"Reliability-Centered Maintenance"- Stanley F. Nowlan and Howard F. Heap of United Airlines.**
 - **Available from NTIS via web**
- **RCM: Gateway to World Class Maintenance- Mac Smith & Glenn Hinchcliffe (2003)**
 - **Available in book stores**
- **RCM II Reliability-centered Maintenance, 2nd Edition- John Moubray 1997**
 - **Available in book stores**

INTRODUCTION TO RCM

Review and Summary

Module Objective

- Overview of the Reliability-Centered Maintenance (RCM) Process.

Introduction

- Learning Objectives

RCM Overview

- RCM Definition
- Benefits of RCM
- History
- References

End of Module

up next.....

NAVAIR RCM Policy & Organization